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## FOSSIL PLANTS FROM CHUBUT TERRITORY COLLECTED BY THE SCARRITT PATAGONIAN EXPEDITION<sup>1</sup>

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Last November Dr. George Gaylord Simpson forwarded to me for study the fossil plants collected by the Scarritt Patagonian Expedition. These comprised five small lots from southern Chubut Territory and are not only few in number, but in a very poor state of preservation.

Two lots came from the Upper Cretaceous Salamanqueano series at Cerro Abigarrado south of Lago Musters (field number P1) and Estancia Las Violetas, west of Bustamante (field number P2). The former contains several small lanceolate dicotyledonous leaves with unobservable venation and wholly lacking generic characteristics. The latter contains silicified coniferous wood and the fragment of a medium-sized dicotyledonous leaf that seems clearly to belong to the family Lauraceæ, although it is generically undeterminable. The remaining three lots contain material not quite so indefinite and worthy of being placed on record.

Field number 417 represents specimens found in digging a well between the Río Chico and the coast near Cañadón Hondo, which enters Río Chico near Paso Niemann. The well starts about 65 meters below the level of Pampa Castillo on the Patagonian horizon, and the fossil plants come from a depth of 35 to 37 meters. The matrix is a gray, rather friable tuff, and the specimens were presented to the Scarritt Patagonian Expedition by Juan Roux. The species represented are *Nothofagus simplicidens* Dusén (Amer. Mus. No. B-16), *Nothofagus densinervosa* Dusén, *Fagus subferruginea* Dusén (Amer. Mus. No. B-17) and *Laurelia amarillana* Berry (Amer. Mus. No. B-18).

Field number 421 is a group of impressions found in laminated clays in Cañadón Hondo, and the beds are said to represent the *Notostylops* horizon.<sup>2</sup> The plants represented include numerous leaves of *Embothriophyllum dubium* Dusén (Amer. Mus. No. B-6), a single fragment of a leaf (Amer. Mus. No. B-5) which is the same as *Phyllites* 3 Dusén from the Seymour Island Tertiary, and a winged seed (Amer. Mus. No. B-4)

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<sup>1</sup>Publications of the Scarritt Patagonian Expedition, No. 3.

<sup>2</sup>Exact stratigraphic data will be given in a later paper by Simpson.

probably from the same plant as the leaves referred to *Embothriophyllum* and belonging to the family Proteaceæ, which is described on a subsequent page as a new species of the genus *Embothrites* of Unger.

Field number 455, which is from the same locality as number 421 and collected about a month later, furnishes *Scirpites* sp. Dusén (Amer. Mus. No. B-11), *Rhoophyllum nordenskjöldi* Dusén (Amer. Mus. No. B-9), *Embothriophyllum dubium* Dusén (Amer. Mus. No. B-7), *Knightia andreæ* Dusén (Amer. Mus. No. B-8), and *Phyllites* 2 Dusén (Amer. Mus. No. B-2).

Field number 455A was found near 455 and about 10 feet higher. It furnishes several varieties of undeterminable dicotyledonous leaves, fragments of leaves of some grass or sedge (Amer. Mus. No. B-13), and a fragment of *Embothriophyllum dubium* Dusén (Amer. Mus. No. B-14).

The result is a small list of species definitely from beds which are mammal-bearing and represent the *Notostylops* and perhaps the *Pyrotherium* horizons, and all species are also found at other localities either near Lago Nahuel Huapi,<sup>1</sup> Punta Arenas on the Straits of Magellan,<sup>2</sup> on the coast of Tierra del Fuego,<sup>2</sup> or on Seymour Island on the coast of Graham Land,<sup>3</sup> but in these other localities not associated with mammals.

They are thus of very considerable geological importance and palæobotanical interest, despite their small number, poor preservation, and somewhat vague systematic position.

This list comprises:

*Scirpites* sp. Dusén  
 Grass or sedge leaves  
*Embothriophyllum dubium* Dusén  
*Embothrites*, n. sp.  
*Rhoophyllum nordenskjöldi* Dusén  
*Knightia andreæ* Dusén  
*Phyllites* 2 Dusén  
*Phyllites* 3 Dusén  
*Nothofagus simplicidens* Dusén  
*Nothofagus densinervosa* Dusén  
*Fagus subferruginea* Dusén  
*Laurelia amarillana* Berry

The last four species which were included under field number 417 have not been encountered at the localities of numbers 421, 455 and 455A,

<sup>1</sup>Berry, Edward W. 1928. "Tertiary Fossil Plants from the Argentine Republic," U. S. National Museum Proc., LXXIII, Art. 22.

<sup>2</sup>Dusén, P. 1899. "Über die tertiäre Flora der Magellansländer," Svenska Exped. Magellansland, Bd. 1, No. 4. Gilkinet, A. 1909. "Quelques plantes fossiles des terres Magellaniques." Resultats voyage du S. Y. Belgica en 1897, 1898, 1899.

<sup>3</sup>Dusén, P. 1908. "Über die tertiäre Flora der Seymour-Insel," Wiss. Ergeb. Schwed. Südpolar-Exped. 1901-1903, Bd. 3, Lief. 3.

and there is some evidence that the horizon of number 417 is slightly younger than the other two localities. This evidence consists in the presence of *Laurelia amarillana*, elsewhere known from Rio Chalia in Santa Cruz Territory associated with a flora which seemed to me to be distinctly younger than the *Fagus* zone, if the latter be assumed to have a precise stratigraphic significance, which is not certain. This would place it above the Magellanian marine transgression and at approximately the horizon of the *Araucaria* zone, assuming again that the latter has a precise stratigraphic significance, which again is not certain. In terms of the Patagonian mammalian succession, this would make number 417 a possible correlative of the *Pyrotherium* (Deseado) horizon, which I would regard as upper Oligocene or lower Miocene. The mammals which the Scarritt Patagonian Expedition collected at the horizon of the plants under number 417 may be expected to settle the question of whether the horizon is *Notostylops* or *Pyrotherium* and thus clear up part of this palæobotanical uncertainty, although the fact that this lot was found in a well at some distance from corresponding surface exposures introduces a further stratigraphic difficulty.

The other floras with which any of these fossil plants can be compared are those from the Arauco district of Chile, which I have regarded as lower Miocene,<sup>1</sup> and that described by me from Mirhoja in Chubut Territory,<sup>2</sup> which I regarded as Santa Cruz in age, i.e., later than the Patagonian marine transgression.

The chief reason for caution in accepting the foregoing as final is the fact that the other species associated with the *Laurelia* under number 417 occur in the territories of Rio Negro, Magellanes and Tierra del Fuego in what have the appearance of being *Fagus* zone associations.

The distribution of the plants in the present collection is shown in the table on page 4. It seems clear from the table, and from the distribution of all of the fossil species from southern South America and Graham Land, that the so-called *Fagus* zone and *Araucaria* zone are not very different in age or in ecologic significance, although Dusén regards the latter as considerably younger and indicative of a milder climate. Gilkinet considered the Baguales florule as younger than the other Magellan florules and emphasizes the recent aspect of the plants from all of these localities. This is an illusion due to the fact that the Eogene climatic conditions from about Latitude 40° southward to

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<sup>1</sup>Berry, Edward W. 1922. "The Flora of the Concepcion-Arauco Coal Measures of Chile," Johns Hopkins University Studies in Geology No. 4.

<sup>2</sup>Berry, Edward W. 1925. A Miocene Flora from Patagonia. Idem. No. 6.

|                                  | Río Negro Territory |                                | Chubut Territory                                   |                                    |         |                                                   | Magellan Territory                 |          |                | Tierra del Fuego          |            |                             |
|----------------------------------|---------------------|--------------------------------|----------------------------------------------------|------------------------------------|---------|---------------------------------------------------|------------------------------------|----------|----------------|---------------------------|------------|-----------------------------|
|                                  |                     |                                |                                                    |                                    |         |                                                   |                                    |          |                |                           |            |                             |
|                                  |                     | Near Bernal S. E. of Barrioché | Río Nirihuanó 4 leagues south of Lago Nahuel Huapi | No. 417 ? <i>Ptyrotherium</i> beds | No. 421 | {<br><i>Nostylops</i> beds<br>No. 455<br>No. 455A | Río de las Minas near Punta Arenas | Baguales | Cabeza del Mar | Barrancas de Carmen Sylva | Río Condor | Seymour Island, Graham Land |
| <i>Embothriophyllum dubium</i>   |                     |                                |                                                    |                                    | ×       |                                                   | ×                                  |          |                |                           |            |                             |
| <i>Embolhrites simpsoni</i>      |                     |                                |                                                    |                                    | ×       |                                                   |                                    |          |                |                           |            |                             |
| <i>Fagus subferruginea</i>       |                     | ×                              |                                                    | ×                                  |         |                                                   | ×                                  |          | ×              | ×                         |            |                             |
| <i>Knightia andree</i>           |                     |                                |                                                    |                                    |         | ×                                                 |                                    |          |                |                           |            | ×                           |
| <i>Laurelia amarillana</i>       |                     |                                |                                                    | ×                                  |         |                                                   |                                    |          |                |                           |            | ?                           |
| <i>Nothofagus densinervosa</i>   |                     |                                |                                                    | ×                                  |         |                                                   |                                    |          | ×              | ×                         | ×          |                             |
| <i>Nothofagus simplicidens</i>   |                     |                                | ×                                                  | ×                                  |         |                                                   | ×                                  | ×        |                | ×                         | ×          | ?                           |
| <i>Phyllites 2</i>               |                     |                                |                                                    |                                    |         |                                                   |                                    |          |                |                           |            | ×                           |
| <i>Phyllites 3</i>               |                     |                                |                                                    |                                    | ×       |                                                   |                                    |          |                |                           |            | ×                           |
| <i>Rhoophyllum nordenskjöldi</i> |                     |                                |                                                    |                                    |         |                                                   | ×                                  |          |                |                           |            |                             |
| <i>Scirpites</i> sp.             |                     |                                | ×                                                  |                                    |         |                                                   |                                    |          |                |                           |            | ×                           |

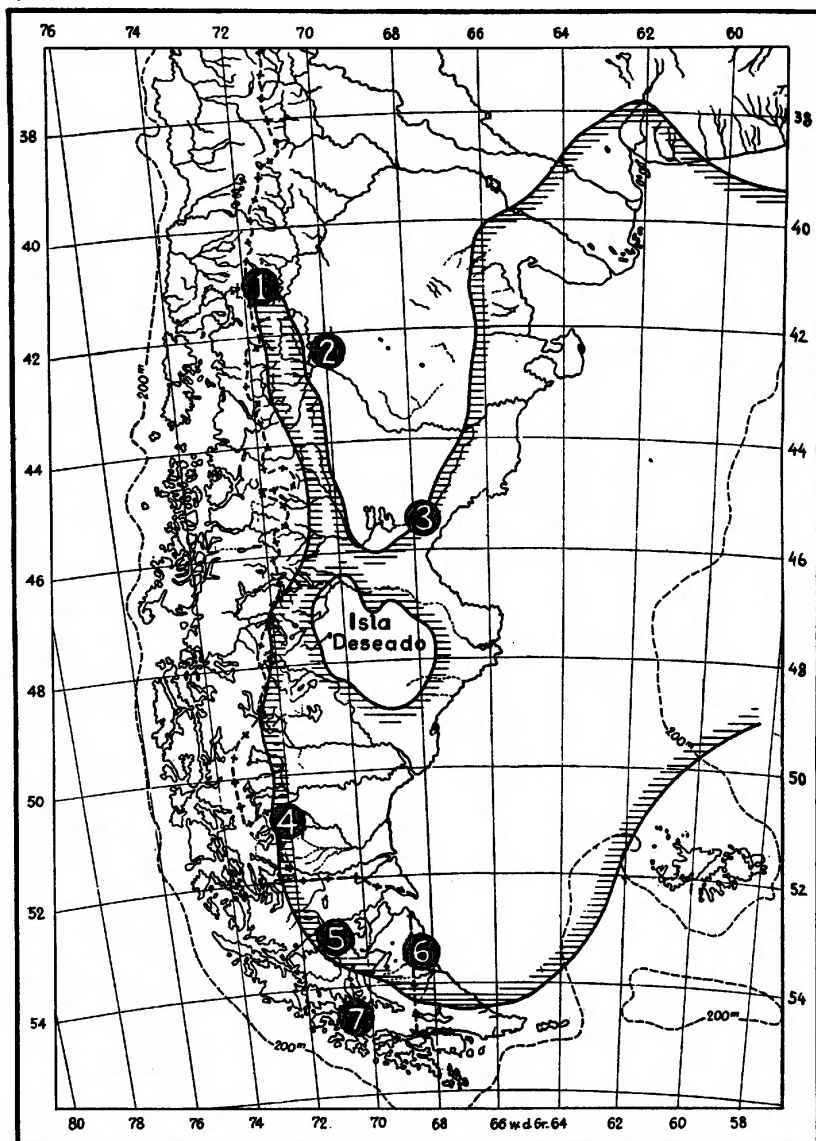


Fig. 1. Tertiary plant localities in Patagonia, on base map showing Patagonian marine transgression by Windhausen.

1. Lago Nahuel Huapi.
2. Mirhoja.
3. Searritt Patagonian Expedition localities in Cañadón Hondo.
4. Río Chalia region.
5. Punta Arenas, Cabeza del Mar, etc., on Straits of Magellan.
6. Barrancas de Carmen Sylva.
7. Baguales, etc.

Graham Land were somewhat similar to those which exist to-day in southern Chile and that the present survivors occur in the same general region. It was not clear from the studies of Engelhardt, Dusén, Hatcher, and Gilkinet in the Straits of Magellan region just where the *Fagus* and *Araucaria* zones belonged in the general Tertiary section of Patagonia,

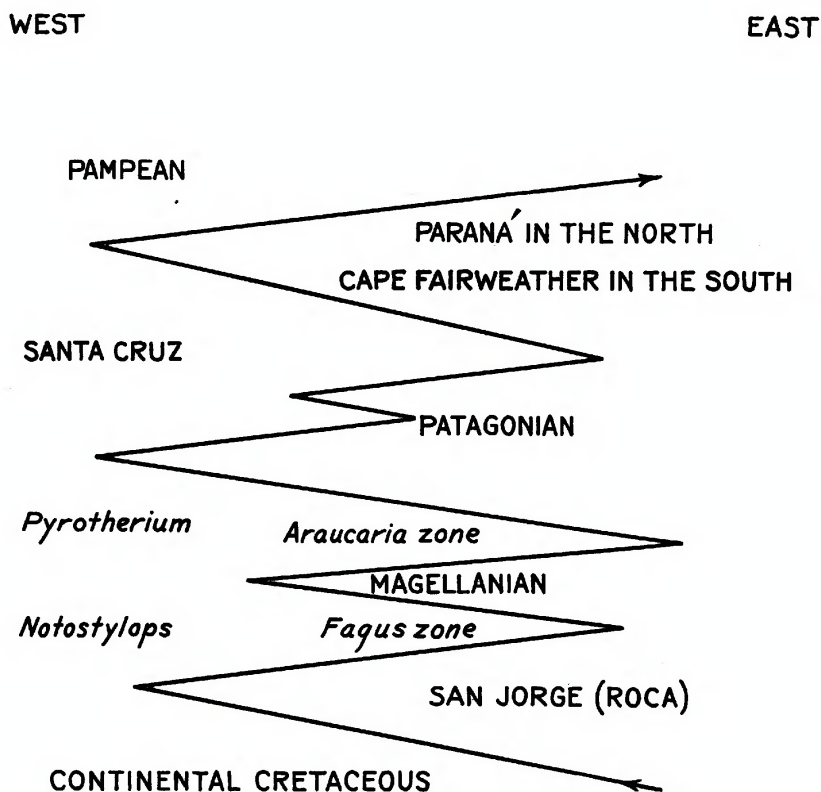


Fig. 2. Diagram of the movement of the strand line in Patagonia during the Tertiary.

but my studies of the florules from the Lago Nahuel Huapi region and of those collected by the Scarritt Patagonian Expedition show that all these flourished previous to the Patagonian marine transgression and are therefore pre-Miocene.

Moreover, the presence of a different flora at Mirhoja and in the Rio Chalia region (Localities 2 and 4 on the accompanying sketch map, Fig. 1) shows that this region, at least between Latitudes 42° and 51°

South, was occupied subsequent to the Patagonian transgression by a more varied and milder climate flora, quite different from the earlier *Fagus-Araucaria* floras, one whose descendants do not extend south of the Argentine Mesopotamia at the present time, at least east of the Andes. I am reproducing in the accompanying text figure (Fig. 2) my conclusion regarding the relations of the various formational units with reference to movements of the strand line. This does not differ from the diagrams published in 1921 and 1925 except that the standard names Eocene, Oligocene, etc., are omitted, since it is possible that the San Jorge (Roca) marine transgression may have been late Cretaceous instead of Eocene, which might make the *Notostylops* mammal zone and the *Fagus* plant zone older Eocene than I formerly indicated. The elaboration of the mammals collected by the Scarritt Patagonian Expedition it is hoped will settle the position of the Patagonian history depicted in terms of the standard world section of the Tertiary.

There follow comments on certain of the plants collected by the Scarritt Patagonian Expedition:

#### THE FAGACEÆ

One species, which Dusén considered a *Fagus*, occurs under field number 417 (Amer. Mus. No. B-17) and at four other localities in the territories of Rio Negro, Magellanes and Tierra del Fuego. I am not convinced that *Fagus* can be distinguished from *Nothofagus* on the evidence of the leaves alone.

Two species from field number 417 are referred to *Nothofagus*. Dusén recorded 13 species and varieties of *Nothofagus* and two of *Fagus* from the Strait of Magellan and Tierra del Fuego, and the specific limits are such that the two which I have identified from southern Chubut Territory might perhaps be compared with some of the leaves which have been referred to *Nothofagus magellanica* Engelhardt, *Nothofagus variabilis* Dusén or *Nothofagus serrulata* Dusén, but this would in no wise alter the geologic or ecologic significance of their occurrence.

The genus *Nothofagus* was proposed by Blume for a group of antipodean species, some evergreen and others deciduous, which had formerly been referred to the Holarctic genus *Fagus*. Three or four are found in southeastern Australia and Tasmania, six in New Zealand and eight in Chile and the Andean border of southern Argentina. They are undoubtedly related to the northern *Fagus*, but the present disconnected distribution of the two has never been explained satisfactorily. One of the two Tasmanian and five of the Chilean species are deciduous.

Whether *Nothofagus* to-day represents the end products of a Cretaceous dispersal from the Northern Hemisphere or whether there has been some direct interchange of southern species by way of Antarctic lands, cannot be settled. Dusén believed that certain Eocene species from Patagonia were to be referred to *Fagus* instead of *Nothofagus*, but the known material, which is entirely foliar in nature, does not seem to me conclusive. There are also certain leaves in late Cretaceous and early Tertiary floras of the Northern Hemisphere which greatly resemble those of *Nothofagus* and whose true affinity I do not believe can be determined from the leaves alone, although Bandulska<sup>1</sup> has recently decided from cuticular studies that an Eocene species from Bournemouth, England, is a *Nothofagus* and not a *Fagus*. Fossil species of *Nothofagus*, from Australia, New Zealand, Tasmania, and Patagonia, have been described by Ettingshausen, Unger, Gilkinet, Englehardt, and Dusén, and all of these authors, especially the last, have been guilty of over-refinement in specific differentiation. From a slight experience with living forms in southern Chile, I am convinced that many of these quondam species might be included within the limits of variation of a single botanical species, especially when present within rather narrow geographic and stratigraphic limits as is the case with Dusén's species. Although I have retained both *Nothofagus simplicidens* and *Nothofagus densinervosa*, I doubt their specific distinctness.

Petrified wood referred to *Nothofagoxydon* has been identified from Chile, Tierra del Fuego, Patagonia and Seymour Island.

***Embothrites simpsoni* Berry, n. sp.**

Figure 3

TYPE.—Amer. Mus. No. B-4, impression and counterpart of seed.

Seeds compressed, bifacial, prominently winged, elongate-elliptical in outline, length about 19.5 millimeters, maximum width about 6.5 millimeters about half-way between apex and base. Hilum prominent, funiculate. The essential part of the seed is half-way between the base and apex of the wing on one side and is connected by a marginal strand of raphe-like vascular tissue. The seed is either anatropous or amphitropous, compressed, elongate-elliptical in outline. The wing is finely and transversely veined. Named for Dr. George Gaylord Simpson, the leader of the Scarritt Patagonian Expedition.

This winged seed appears to be referable to the family Proteaceæ, and the most obvious comparison is with the winged seeds of the South

<sup>1</sup>Bandulska, H. 1924. Jour. Linn. Soc. Bot., XLVI, p. 433

American genus *Embothrium*, since the seed is associated with *Embothrium*-like leaves referred to *Embothriophyllum dubium* Dusén. In the modern flora, *Embothrium* has four species in South America, ranging from the Straits of Magellan northward along the west coast of South

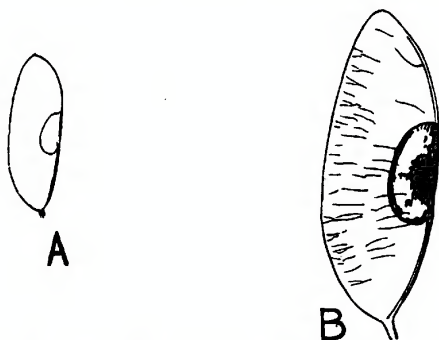


Fig. 3. *Embothrites simpsoni* Berry, new species.  
Type, Amer. Mus. No. B-4. a. Natural size. b. Twice natural size.

America to about Latitude 33° South, and a single species in Australia. Several fossil species based upon foliage have been described from the Oligocene and Miocene of southern Europe. Seeds of the general character of *Embothrium* have also been found fossil and are generally referred to the genus *Embothrites* proposed by Unger in 1850 for specimens from Sotzka, Styria. Eight to ten species have been described, all of which except the present species and one from the Oligocene of the southern United States are south European.

The present species differs from all the others known to me in having the seed moved upward in the wing a considerable distance from the hilum. In spite of the fact that many other plants have winged fruits and seeds of somewhat similar appearance, I think it a safe conclusion that the seed (*Embothrites*) and the associated leaves (*Embothriophyllum*) should be referred to the Proteaceæ and are probably related to the existing species of *Embothrium*, but it is possible that they may represent an extinct genus, since the disconnected distribution of the modern species indicates a long antecedent history.

The whole question of the geologic history of the Proteaceæ has been one that has inspired a considerable acrimonious controversial literature and was discussed at considerable length by me in 1916.<sup>1</sup> The modern and ancient distribution is too extensive a subject for dis-

<sup>1</sup>Berry, E. W. 1916. U. S. Geol. Survey Prof. Paper 91, pp. 83-87 (map).

cussion in this place. The presence of *Embothriophyllum*, *Embothrites* and a supposed *Knightia* in the Patagonian Eocene renders it pertinent, however, and I can only say that unless one is prepared to subscribe to the doctrine of the independent origin of the same genera on different continents, then one must admit that the ancestors of the existing species ranged over intervening areas and that the fossils which resemble them are related to them, which was disputed by Bentham and Hooker, or else fossils which do not resemble them are related to them, and this last, it seems to me, is absurd.

***Rhoophyllum nordenskjöldi* Dusén**

Amer. Mus. No. B-9, the specimen and counterpart included in field number 455 which I have referred to this species, is absolutely identical with the type material which Dusén figures from Rio de las Minas near Punta Arenas, and has, moreover, a characteristic and easily recognized venation.

Although Dusén nowhere states the basis for his pseudogeneric name of *Rhoophyllum* to which he referred two species from Patagonia, I have always supposed it meant that they resembled the leaflets of various existing species of the subfamily Rhoideæ of the family Anacardiaceæ.

This is quite an extensive group, and at least six of the genera are South American. These are *Haplorhus*, *Thyrsodium*, *Mauria*, *Schinus*, *Lithræa*, and *Schinopsis*. The last three are members of the existing flora of the Argentine Republic, and *Rhoophyllum nordenskjöldi* from Punta Arenas and Cañadón Hondo, Chubut, might very well represent an extinct species belonging to any one of these three genera, the excuse for maintaining *Rhoophyllum* being the impossibility of deciding the generic relations more precisely.